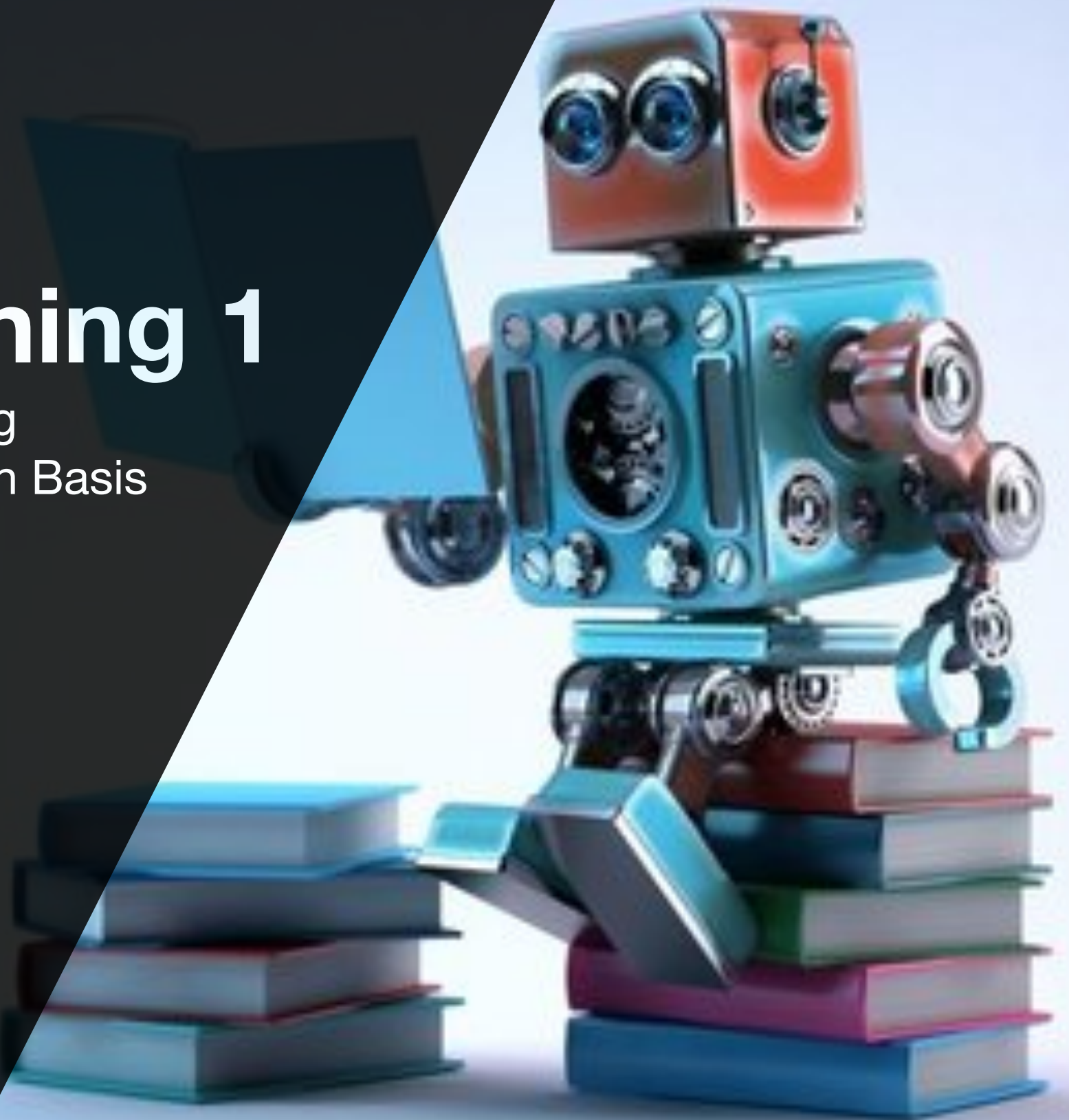


Machine Learning 1

Lecture 7.1 - Supervised Learning
Classification - Classification With Basis
Functions

Erik Bekkers

(Bishop 4.3.1)



Example: Use of Basis Functions

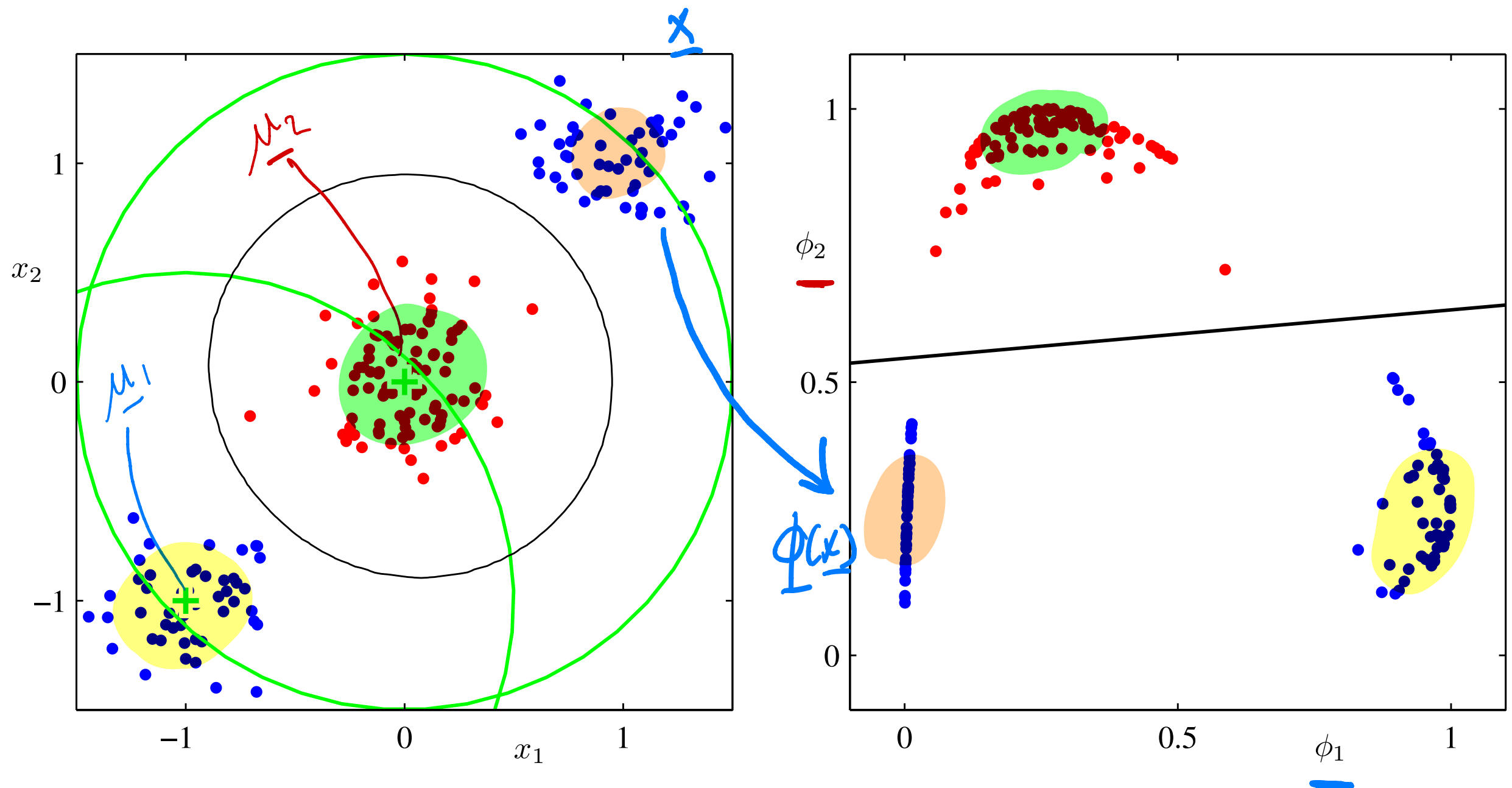


Figure: Left: original input space (x_1, x_2) , right: space of two gaussian basis functions with centres shown by the green crosses. (Bishop 4.12)

$$\phi_1(x) = \exp\left(-\frac{1}{2}(x-\mu_1)^T(x-\mu_1)\right)$$

$$\phi_2(x) = \exp\left(-\frac{1}{2}(x-\mu_2)^T(x-\mu_2)\right)$$

Limitations of Fixed Basis Functions

Advantages:

- ▶ Closed form solution for least-squares problem
- ▶ Tractable Bayesian treatment
- ▶ Nonlinear models mapping input variables to target variables through basis functions

Limitations:

- ▶ Assumption: Basis functions $\phi_j(\mathbf{x})$ are fixed, not learned.
- ▶ Curse of dimensionality: to cover growing dimensions D of input vectors, the number of basis functions needs to grow rapidly / exponentially